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Dept. of Ecology Water Quality Program
Randall Marshall

Toxicity Testing to Establish the Environmental Safety of Proposed Ballast Water Biocides

Purpose of Ballast Water Biocide Toxicity Testing Procedures

The Washington Department of Fish and Wildlife (WDFW) has been tasked by the state legislature with setting standards for ballast water treatment and coordinating a two panel (science advisory panel and maritime advisory panel) review process for technologies proposed for meeting that standard. The Department of Ecology will be advising WDFW on environmental safety issues and setting conditions on the discharge of biocide-treated ballast water.

Which Ballast Water Biocides Need Toxicity Testing?

All ballast water biocides will need some form of testing in order to determine their effectiveness in meeting WAC 220-77-095 which requires inactivation or removal of ninety-five percent of zooplankton organisms and ninety-nine percent of phytoplankton and bacterial organisms. This testing to determine efficacy might include toxicity testing. Toxicity testing is also needed to determine conditions when the potential for the biocide to harm receiving water organisms is unacceptable. Solely physical ballast water treatment methods such as filtration, centrifugation, ultraviolet irradiation, or oxygen stripping are assumed to not need toxicity testing.

Biocide Toxicity Tests

The testing should include a 96-hour acute toxicity test with silverside minnows, a 48-hour acute toxicity test with a mysid, and a 48-hour bivalve embryo-larval survival and development test. If 7-day chronic tests are determined to be necessary due to multiple discharges at the same location in the same week, then the 7-day survival and growth tests using silverside minnows and mysids must be conducted. The results from the most sensitive test will be used in making decisions.

The goal of the testing described in this document is not routine monitoring of ballast water toxicity just prior to discharge but to establish in other ways how to keep ballast water toxicity from being an environmental threat. If any toxicity test ever becomes established to our satisfaction as being reliable and convenient enough for routine use on a ship, then this document will be revised to allow for its use instead of the other testing described here.

Biocide Toxicity Testing to Demonstrate Zero Toxicity at Ballast Water Discharge

The toxicity of a biocide in ballast water must begin as highly toxic and gradually become nontoxic due to volatilization, reaction, or degradation or it will either be ineffective or too risky to discharge. Toxicity testing will be used to demonstrate this process and to verify that no other toxic compounds have formed which might persist longer than the biocide. The results of the ballast water biocide time series toxicity testing must be submitted to the Department of Ecology Water Quality Program's Whole Effluent Toxicity (WET) Coordinator for determination of the time to zero toxicity. The earliest sample to have no statistically significant toxicity relative to a control will be the indicator of the minimum time needed before discharge.

Biocide Toxicity Testing to Maintain Moderate Residual Toxicity at Ballast Water Discharge

Moderate toxicity at the time of ballast water discharge may be necessary for some biocides to accomplish the intended purpose of preventing the introduction of potential disease organisms. The results of the ballast water biocide definitive toxicity testing must be submitted to the Department of Ecology Water Quality Program's Whole Effluent Toxicity (WET) Coordinator for calculation of the toxic threshold and determination of the target discharge concentration.

Using a Combination of Testing Strategies May Make Sense

Performing both of the testing strategies described above may make good sense. Testing to demonstrate zero biocide toxicity at ballast water discharge is preferable if the biocide performance is good enough. However, a ship may not always be able to wait for the entire time period needed for biocide toxicity to disappear before discharging ballast water. Testing to determine a biocide concentration that is moderately toxic but considered safe to discharge will give ships some potentially useful flexibility in discharge timing.

Toxicity Testing to Verify Biocide Neutralization

After a demonstration that the neutralizing chemical can effectively eliminate biocide toxicity without any toxic reaction products, toxicity testing will focus on determining the safety margin for the neutralizing chemical so that care can be given to prevent the toxic threshold of the neutralizing chemical from ever being reached.

Report to the WDFW Aquatic Nuisance Species Coordinator

The WET Coordinator will make a report to the WDFW Aquatic Nuisance Species Coordinator for inclusion in the interim ballast water discharge standard approval process in WAC 220-77-095. The report will also note any concerns the Department of Ecology may have about the biocide's persistence, ability to bioaccumulate, or potential hazards to human health.

Randall Marshall
WET Coordinator
360-407-6445 or rmar461@ecy.wa.gov
WA WET webpage: http://www.ecy.wa.gov/programs/wq/wet